Beefing it up

A new study highlights the future environmental pressures of livestock production. **Nigel Williams** reports.

Livestock production for human consumption is growing dramatically as developing nations increasingly eat meat. But the production of such animals adds to greenhouse gas emissions and takes up biomass production that could otherwise enter the human food chain directly.

Nathan Pelletier and Peter Tyedmers at Dalhousie University have calculated the possible impacts of livestock production between 2000 and 2050 in a new report in the *Proceedings of the National Academy of Sciences* (published online).

"As of 2000 the livestock sector is estimated to have contributed 14 per cent of anthropogenic greenhouse gas emissions, 63 per cent of reactive nitrogen mobilization and consumed 58 per cent of directly used human appropriated biomass globally."

Using simplified and conservative models, the authors write, they estimate that production of livestock in 2050 at levels projected by the UN Food and Agricultural Organization may increase direct livestock-related greenhouse gas emissions from meat, milk and egg production in the order of 39 per cent, biomass appropriation by 21 per cent and reactive nitrogen mobilization by 36 per cent above reported 2000 levels.

On current trajectories, it is estimated that anthropogenic climate change may increase global mean temperatures by 3ºC by 2100. As a rise of 2ºC above preindustrial levels may result in "dangerous climate change" with serious negative impacts to ecosystems and human welfare, this issue has moved to the fore in government policies around the globe, they write.

The Intergovernmental Panel on Climate Change estimates the direct contribution from agriculture at 10-12 per cent of greenhouse gas emissions, without counting for the effect of clearing land for agricultural production.

With that included, one recent study suggests that livestock production comprises 17–32 per cent of anthropogenic emissions.

The EU has studied the issue, and concludes that food production contributes 31 per cent to total emissions, a large part of which is livestock production.

Although nitrogen is essential to all life forms and is also the most abundant element in the Earth's atmosphere it exists there in a stable form inaccessible to most organisms until fixed in a reactive form. The supply of reactive nitrogen plays a pivotal role in controlling the productivity, carbon storage, and species compositions of ecosystems. Since the industrial revolution, annual anthropogenic reactive nitrogen emissions have increased to the extent that human activities now contribute more fixed nitrogen to terrestrial ecosystems than do all the natural systems combined. Background levels have effectively doubled since 1970 and continue to rise rapidly, the authors write.

Pressures: Growing livestock production increases demand on environmental resources. (Picture: Photolibrary.)

"Half of the synthetic nitrogen fertilizer ever used on Earth has been applied in just the last 15–20 years. Of this fraction, it is estimated that only 10–20 per cent was actually consumed by humans, 95 per cent of which was subsequently lost to the environment," they say.

Global estimates of biotic resource use have been reported by several researchers. At present, it is estimated that humans appropriate 24 per cent of potential net primary productivity with the food system consuming 12 per cent. Some estimates have suggested that up to 58 per cent of human-appropriated biomass was used for livestock production in 2000.

We suggest that potential contributions of livestock production to global environmental change ... indicate that reining in growth in this sector should be a policy priority.

"We use simplified but robust models to conservatively estimate the aggregate greenhouse gas emissions, reactive nitrogen mobilization, and the biomass appropriation potentially associated with producing edible livestock products in 2050," they write.

"Specifically, we evaluate four endpoint scenarios based on projected and alternative production and consumption patterns intended to illustrate the range of impacts associated with dietary choice at a global scale."

The authors note the difficulty of their predictions but are clear about the potential impacts of unrestrained growth in livestock production. "Although embodying considerable uncertainty, our models indicate that, by 2050, the livestock sector alone may either occupy the majority of, or considerably overshoot, current best estimates of humanity's safe operating space," in each of the areas of greenhouse gas emissions, biomass consumption and nitrogen usage.

In each of these domains, on this basis, the authors suggest that the potential contributions of livestock production to global environmental change indicate that "reining in growth in this sector should be a policy priority."

Banking insights

After the recent crisis, bankers are increasingly looking to scientific advice. **Nigel Williams** reports.

One of the outcomes of the banking crisis two years ago has been a growing interest in garnering scientific advice to help shape policy. For some years, bankers have been increasingly interested in the possible insights that biologists might have into banking activity. But the recent crisis has raised the game.

Mervin King, governor of the Bank of England, convened a group of scientists two years ago to help develop policy on the basis of a biological understanding of human behaviour and the banking system.

But a precedent was a report, begun in 2006 by the US National Academy of Sciences and the Federal Bank of New York, following the observation that, although much effort and sophisticated analyses were increasingly directed towards maximising returns with minimum risk for individual banks and investment firms, essentially no action was being paid to studying the concomitant changing dynamics of the entire system, that is, to study 'systemic risk'.

The study brought together around 100 experts from 22 countries, representing banks, regulators, investment firms, US national laboratories, government agencies, and universities, with the aim of exploring parallels between systemic risk in the financial sector and that in selected domains of engineering, ecology and other fields of science. As events have unfolded, there are new questions as to what kind of regulatory reforms might be put in place.

Robert May and Nimalan Ariaminpaithy at the University of Oxford have taken the link between biological systems and banks further with a recent paper in the *Royal Society Interface* (*7*, 823–828) to develop mathematical models for banking systems and the reduction in systemic risk.

And in a new analysis, May has worked with Andrew Haldane, executive director of financial stability at the Bank of England, to produce an analysis to back the split between retail and investment banking. Biology has always offered insight into human activity but it seems it might have greater than imagined impact on the latest banking crisis.

Learning: The Bank of England is taking more scientific advice to help guide future policy. (Photo: Bank of England.)